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(74) Agent: **FISHER ADAMS KELLY**; Level 13, AMP Place,
10 Eagle Street, Brisbane, QLD 4000 (AU).

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(71) Applicants and

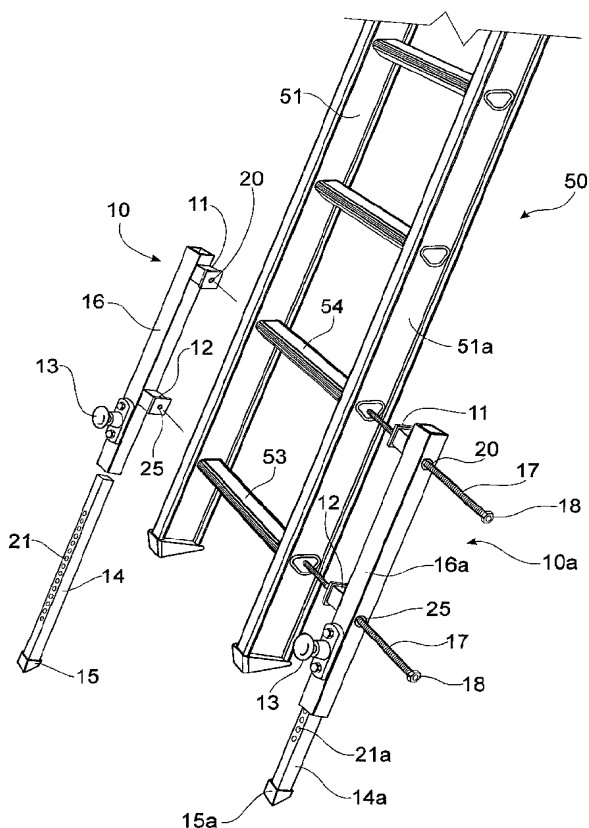
(72) Inventors: **SCOTT, Jon, Robert** [AU/AU]; 92 Douglas
Street, Oxley, Queensland 4075 (AU). **RICHARDS, An-**
drew, Anthony [AU/AU]; 59 Long Street West, Graceville,
Queensland 4075 (AU).

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(54) Title: LEVELLING APPARATUS FOR A SUPPORT STRUCTURE



(57) Abstract: A levelling apparatus for levelling a support structure (50), for example a ladder or scaffold, on an uneven surface and a method for attaching the levelling apparatus to the support structure. The apparatus comprises an inner member (14, 14a) telescopically movable within a housing (16, 16a) which may be secured at a desired length by a securing means (13, 21). In use, the housing (16, 16a) is attached to the support structure (50) using an attachment means (17, 18, etc) which at least partially extends into an interior of a cross-member of the support structure (50), for example a ladder rung (53).

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TITLE

“LEVELLING APPARATUS FOR A SUPPORT STRUCTURE”

FIELD OF THE INVENTION

5 THIS INVENTION relates to a levelling apparatus for a support structure, for example a ladder or scaffold, on an uneven surface and method for attaching the levelling apparatus to the support structure.

BACKGROUND OF THE INVENTION

10 Ladders and scaffolding are preferably used on a level surface for good stability. However, it is not uncommon to encounter situations where a surface is uneven or on an incline. Use of a ladder or scaffolding on such a surface may pose a danger to a person climbing the ladder or scaffolding. In some situations it may be possible to level the surface, for example, if the surface is dirt or gravel. However, levelling a
15 dirt or gravel surface may be time consuming. In some situations the surface may not easily be levelled, for example concrete surfaces and steps. In the past, placing wood blocks or other objects as spacers under a ladder leg have been used to level the ladder. However, using such temporary means may be unsafe. To overcome this problem, ladders and
20 apparatus for adjusting ladders to be level on uneven or sloping surfaces have been developed.

 Levelling apparatus attachable to a ladder are described in US Patent Nos. 4,802,471; 5,335,754; 4,606,432 and 4,607,726. These patents relate to apparatus comprising an extension leg which may be
25 extended and secured at different lengths.

 US Patent No. 4,802,471 relates to an extendable leg which attaches to a lower end of a ladder side rail. The extendable leg when extended functions as a ladder support leg. The telescopic leg is

securable at a desired extended length by using a gripping device having a sharp edge which locks an inner extendable rail relative to an outer rail. The extendable leg is attached to the ladder by bolts which are fixed to the ladder side rail. Attaching this apparatus requires drilling of holes in the ladder side rail to accommodate the bolts.

US Patent No. 5,335,754 relates to a self-levelling ladder and to a leveller which may be attached to an existing ladder. The ladder leveller comprises a sleeve which slides over a bottom end of a ladder side rail. The sleeve functions as an extendable leg which extends away from the bottom end of the ladder side rail. When installing the ladder leveller to an existing ladder, an elongate slot is cut in each side rail through which a bolt is fitted. The bolt may be horizontally slid within the slot to lock and unlock the sleeve at a desired extended length by engaging receiving notches on the sleeve.

US Patent No. 4,606,432 describes an adjustable ladder comprising a telescopic extension leg which may be attached to a ladder using clamping members adapted to fasten to a ladder side rail. The clamping members encircle the ladder side rail and are secured by bolts which fix the clamping members together.

US Patent No. 4,607,726 relates to a telescopic ladder leg extension apparatus which attaches to a bottom side rail of an existing ladder. Two U-shaped notches receive adjacent ladder rungs respectively and with additional lock screws secure the apparatus to the ladder.

Apparatus for levelling ladders as described in US Patent Nos. 4,802,471 and 5,335,754 require additional equipment, time and skill to drill holes in existing ladder side rails. Such holes may weaken the ladder and reduce its structural integrity. US Patent Nos. 4,606,432 and 4,607,726 describe apparatus for levelling ladders which do not require

drilling to attach to existing ladders; however, these apparatus use clamps which have multiple moving parts and may be complicated to manufacture and assemble.

SUMMARY OF THE INVENTION

5 It is an object of the invention to provide a levelling apparatus to overcome one or more of the limitations of, improve upon, or provide an alternative to the prior art as discussed above. The present invention provides a stable and simple means of attaching a levelling apparatus to a support structure and for levelling the support structure on
10 an uneven surface.

 In accordance with one aspect of the invention, a levelling apparatus for a support structure comprising one or more cross-members is provided, said levelling apparatus comprising an attachment means attaching the levelling apparatus to the support structure, the attachment
15 means including attachment member(s) which in use, extends at least partially through at least one of said one or more cross-members.

 The or each attachment member may extend completely through an associated cross-member.

 Preferably, the or each attachment member comprises a rod.
20 A rod may include a shaft, dowel, spike or the like.

 In one embodiment, there are provided two attachment members.

 In another embodiment, there is provided one attachment member.

25 The attachment means may further comprise at least one stabiliser stabilising the levelling apparatus relative to the support structure.

 Preferably, the stabiliser at least partially extends within an

interior of a cross-member.

Preferably, the levelling apparatus further comprises:

a housing attachable to the support structure; and

an inner member telescopically movable within the housing

5 and securable at a desired position relative to the housing; the housing being attachable to the support structure by said attachment means.

Preferably, the inner member is secured to the housing by a securing means which includes a securing member.

Preferably, the securing member comprises a pin and a

10 complementary aperture for securing the pin.

In another aspect the invention relates to a support structure comprising:

one or more cross-members; and

at least one levelling apparatus wherein said levelling

15 apparatus comprises an attachment means attaching the levelling apparatus to the support structure, the attachment means including attachment member(s) which in use, extends at least partially through at least one of said one or more cross-members.

Preferably, the support structure is a ladder.

20 In one embodiment, the ladder comprises one levelling apparatus.

In another embodiment, the ladder comprises two levelling apparatus.

Preferably, the or each attachment member extends

25 completely through at least one cross-member.

In a further aspect, the invention relates to a method of attaching a levelling apparatus to a support structure having one or more cross-members, the method including the steps of: respectively inserting

an attachment member at least partially into the or each cross-member; and securing the levelling apparatus thereto.

In use, one or more levelling apparatus may be attached to respective ground engaging ends of respective one or more parallel
5 uprights of a support structure.

A support structure may include a ladder, scaffold, trestle, or like structure. A typical aluminum ladder has rungs which are spaced apart at a standard distance and usually have a hollow interior. The present invention is particularly useful with such an aluminum ladder;
10 however, the invention may also be used with a ladder which is not provided with an existing hollow rung or a ladder comprising hollow rungs attached to side rails without an aperture to allow for access to a hollow interior of a rung. For such ladders, a ladder rung may be modified by creating an aperture through which the attachment rod of the invention
15 may pass there through or a side rail of a ladder may be modified by creating an aperture in the side rail thereby allowing access to an existing hollow interior of a ladder rung. A support plate may be attached to a ladder side rail at a location where such an aperture is made. A example of a support plate is a metal plate with an aperture aligned with the
20 aperture of an end of a ladder rung. Likewise, a scaffold may be modified to accommodate attachment of the present invention.

Throughout this specification unless the context requires otherwise, the word "comprise", and variations such as "comprises" or "comprising", will be understood to imply the inclusion of the stated
25 integers or group of integers or steps but not the exclusion of any other integer or group of integers.

DESCRIPTION OF THE DRAWINGS

In order that the invention may be readily understood and put into practical effect, preferred embodiments will now be described by way of example with reference to the accompanying drawings wherein like reference numerals refer to like parts and wherein:

FIG. 1 is a front view showing two levelling apparatus attached to and levelling a ladder;

FIG. 2 is a side view of FIG. 1;

FIG. 3 is a cross section of FIG. 2 as indicated;

FIG. 4 is an exploded isometric view showing two levelling apparatus and a ladder;

FIG. 5 shows an exploded view of a securing pin that may be used with the invention;

FIG. 6 is an exploded isometric view showing an embodiment of a levelling apparatus comprising a single attachment rod and a stabiliser attached to a ladder;

FIG. 7 shows an embodiment of the invention wherein a single attachment leg comprising two attachment rods is attached to a ladder;

FIG. 8 shows another embodiment of the invention wherein a single attachment leg comprising a single attachment rod and a stabiliser is attached to a ladder; and

FIG. 9 shows a cross section of a single attachment leg attached to a ladder rung.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 shows a bottom part of a support structure, shown here as a ladder 50, comprising two parallel uprights or side rails 51 and

51a and cross-members or rungs 53 and 54 attached therebetween. Levelling apparatus 10 and 10a are shown each comprising inner members 14 and 14a which telescopically move within respective housings 16 and 16a. Levelling apparatus 10 and 10a attach to
5 respective ladder side rails 51 and 51a. Levelling apparatus 10 and 10a are mirror images of each other. Levelling apparatus 10 is adapted to attach to left side rail 51 and levelling apparatus 10a is adapted to attach to right side rail 51a by an attachment means which extends through respective rungs 53 and 54.

10 Ladder 50 is shown in FIG. 1 levelled on uneven surface 30 using levelling apparatus 10 and 10a. Levelling apparatus 10 has inner member 14 telescopically retracted within housing 16 and levelling apparatus 10a has inner member 14a telescopically extended out from housing 16a. Inner members 14 and 14a are secured at a desired length
15 relative to respective housings 16 and 16a by a securing means, shown as securing pin 13 and described in more detail hereinafter. In this configuration, right side of ladder 50 is supported by levelling apparatus 10a which contacts surface 30 at foot 15a. Ladder foot 52a is suspended and no longer engages surface 30.

20 Feet 15 and 15a are angled on their bottom surfaces to provide even contact with surface 30 when the ladder is angled or leaned against an object when in use as shown more clearly in FIGS. 2, 4 and 5. Feet 15 and 15a may also be level and/or pivotable relative to inner members 14 and 14a. Feet 15 and 15a may also comprise grooves or a
25 rough bottom to lessen unwanted movement of the feet relative to surface 30.

Spacers 11 and 12 are shown integral with respective housings 16 and 16a, and in use are located as shown between

respective outer side of side rails 51 and 51a and housings 16 and 16a of respective levelling apparatus 10 and 10a. Spacers 11 and 12 may be of any useful shape and/or size, for example, round, square, hexagonal and triangular. In other embodiments, spacers 11 and 12 may be omitted or
5 may be non-integral with respective housings 16 and 16a.

Levelling apparatus 10 and 10a are attached to ladder 50 by an attachment means, which includes an attachment member shown as rod 17 (shown in FIGS. 3, 4, 6-9) extending through an interior portion of respective rungs 53 and 54.

10 FIG. 2 shows a side view of levelling apparatus 10a attached to right side rail 51a as shown in FIG. 1. Housing 16a of levelling apparatus 10a is attached to ladder 50 by extending rod 17 through respective rungs 53 and 54.

FIG. 3 is a cross-sectional view of ladder 50 and levelling
15 apparatus 10 and 10a as shown in FIG. 2 at indicated arrows 3. FIGS. 3 and 4 more clearly show attachment of levelling apparatus 10 and 10a to ladder 50 in an embodiment wherein two rods 17 extend through an interior of respective rungs 53 and 54. Although levelling apparatus 10 and 10a are designed for use with two rods, a single rod may be used
20 wherein the single rod is inserted through either rung 53 or 54. In another embodiment, a single rod 17 may be used as shown in FIGS. 6 and 8. Rod 17 is shown as a threaded rod with head or fastened nut 18 at one end and secured at an opposite end by moveable nut 19. Moveable nut 19 preferably comprises an unthreaded nylon insert to prevent unwanted
25 unscrewing of the nut when in use. An example of such a nut is a Nyloc nut. A spring washer or pair of lock nuts may also be used to prevent unwanted unscrewing of the nut. Other arrangements of rods and bolts may be used, for example a rod which is only threaded at opposite

terminal ends and two movable nuts fastened thereto. Also, the length of rod 17 may vary to accommodate different lengths of a rung or cross-member. It is understood that rod 17 may refer to an axle, shaft, wand, staff, pole, dowel, spike or other such member either hollow or solid and
5 composed of any material. Preferably, rod 17 is solid metal.

As shown in FIGS. 3 and 4, to attach one embodiment of levelling apparatus 10 and 10a to ladder 50, two rods 17 are inserted through respective apertures 20 and 25 located on housing 16a of levelling apparatus 10a (apertures 20 and 25 extend through respective
10 spacers 11 and 12), through respective apertures on an outer side of side rail 51a aligned with rungs 53 and 54 (rungs shown with hollow interiors), and through corresponding respective apertures 20 and 25 located on spacers 11 and 12 which extend through housing 16 of levelling apparatus 10, which is located adjacent to side rail 51. Movable nuts are threaded
15 onto each rod 17 to securely fasten respective housings 16 and 16a of levelling apparatus 10 and 10a to opposite outer sides of ladder side rails 51 and 51a as shown. Nuts 18 and 19 may be tightened using, for example, an extension socket spanner.

FIG. 4 also shows telescopic extension of inner members 14
20 and 14a within respective housings 16 and 16a. A securing means is provided by a securing member comprising securing pin 13 which is insertable into a respective complementary aperture 21 or 21a located on inner member 14 or 14a respectively to thereby secure inner member 14 or 14a at a desired length relative to respective housings 16 and 16a. To
25 adjust inner member 14 and 14a to a different length, securing pin 13 is pulled outward and removed from complementary aperture 21 or 21a allowing inner member 14 or 14a to telescopically move within respective housing 16 and 16a to a new desired length. A plurality of complementary

apertures 21 and 21a are linearly arranged along inner members 14 and 14a to provide different securable lengths. Securing pin 13 is biased for insertion into respective complementary aperture 21 and 21a. Securing pin 13 may be biased using, for example, a compression coil spring.

5 FIG. 5 shows one embodiment of a securing pin 13 that may be used to respectively secure inner member 14 and 14a relative to housing 16. Securing pin 13 is shown comprising a knob 200, a casing 210, a spring 220 and pin 230. Knob 200 has an internal female threaded aperture 201 to receive and retain male treaded end 231 of pin 230.

10 Casing 210 has a narrow aperture 211 through which a portion of pin 230 comprising threaded end 231 and shaft 232 may pass there through. Passage of pin 230 is obstructed by coiled spring 220, which contacts collar 233 of pin 230. Apertures 213 allow respective screws or other fasteners (not shown) to pass there through to secure securing pin 13 to

15 housing 16. Casing 210 may be attached to housing 16 by other fasteners, including for example a weld or rivet. When welded, apertures 213 may be omitted.

 In use, securing pin 13 is biased by spring 220 so that end 234 of pin 230 inserts into a complementary aperture 21 or 21a located

20 respectively on inner member 14 or 14a. In another embodiment not shown, collar 233 may be replaced with a cir clip that may be inserted into a channel that is located at a same location where collar 233 is shown.

 The present invention is not limited to the securing means described in the figures for adjusting and securing an extendable or

25 telescopic member or leg. The abovementioned pin-and-aperture type securing member is merely one securing means which may be used. Inner member 14 and 14a may be secured relative to respective housing 16 and 16a by other means, including for example, by a plurality of teeth

located on inner member 14 and 14a and a pivotal pawl member located on respective housing 16 and 16a described in AU 76668/81, herein incorporated by reference. Other useful securing means include a plurality of spaced-apart sloping teeth on a housing member and a pin member located on an inner member that is capable of engaging the teeth as described in US Patent No. 5,335,754 and a T-shaped gripping device having a sharp edge which contacts a smooth surface of an adjacent slidable rail as described in US Patent No. 4,802,471; both patents herein incorporated by reference. Other methods for extending and securing extendable legs, for example those methods described in US Patent Nos. 4,606,432 and 4,607,726 may be used. The attachment means of the invention may also be used with a fixed leg which is not adjustable.

FIG. 6 shows another embodiment of levelling apparatus 110 and 110a whereby only a single rod 17 extends through a hollow interior of rung 53. In this embodiment, levelling apparatus 110 and 110a are shown stabilised relative to ladder 50 by stabiliser 111 which is shown as a tapered projection which partially extends within an interior of rung 54. Stabiliser 111 may have other shapes, for example conical or pyramid shaped, a non-tapered shaped, an expandable member which may be expanded to snugly fit within a ladder rung or a clamp which may be attached to an exterior portion of a ladder rung or side rail. Preferably, the stabiliser is at least partially insertable within a hollow interior of a rung or cross-member. Preferably, in use stabiliser 111 prevents levelling apparatus 110 and 110a from rotating around rod 17 which has been inserted through rung 53.

A single levelling apparatus may be attached to a support structure, for example a single side rail of a ladder, as shown in FIGS. 7 to 9. The apparatus shown in FIGS. 7 to 9 function in a manner as

described above like parts are shown having like numbers. Levelling apparatus 10a shown in FIG. 7 comprising two rods 17 and levelling apparatus 110a shown in FIG. 8 comprising a single rod 17 are attached to ladder 50 by extending one or more rods 17 through a hollow interior of a ladder rung 53 and securing an opposite end of the rod 17 with a nut 19 or other suitable fastener. It may be necessary to provide a securing plate 60, which may for example be a washer or a flat metal plate, to provide a surface to prevent nut 19 from passing through the hollow interior of the ladder rung or scaffold member. It will be appreciated that nuts 18 and 19 may both freely rotate or either nut may be fixed to rod 17.

Although the invention has been shown and described with exemplary embodiments thereof, it should be understood by those skilled in the art that the foregoing and various other changes, omissions and additions may be made therein and thereto without departing from the scope of the invention.

The disclosure of each patent and document referred to in this specification is incorporated by reference in its entirety.

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CLAIMS

1. A levelling apparatus for a support structure having one or more cross-members, said levelling apparatus comprising attachment means attaching the levelling apparatus to the support structure, the
5 attachment means including attachment member(s) which in use, extends at least partially through at least one of said one or more cross-members.
2. The apparatus of claim 1 wherein the or each attachment member extend completely through an associated cross-member.
3. The apparatus of claim 1 wherein the or each attachment
10 member comprises a rod.
4. The apparatus of claim 1 wherein there are provided two attachment members.
5. The apparatus of claim 1 wherein there is provided one attachment member.
- 15 6. The apparatus of claim 1 wherein the attachment means further comprises at least one stabiliser stabilising the levelling apparatus relative to the support structure.
7. The apparatus of claim 6 wherein the stabiliser at least partially extends within an interior of a cross-member.
- 20 8. The apparatus of claim 1 whereby said levelling apparatus further comprises:
a housing attachable to said support structure; and
an inner member telescopically movable within said housing and securable at a desired position relative to said housing; said housing
25 being attachable to the support structure by said attachment means.
9. The apparatus of claim 8 whereby said inner member is secured to said housing by a securing means, which includes a securing member.

10. The apparatus of claim 9 whereby said securing member comprises a pin and a complementary aperture for securing the pin.

11. The apparatus of claim 1 wherein the support structure comprises two parallel uprights and a plurality of horizontal cross-members therebetween.

12. The apparatus of claim 1 wherein the support structure is a ladder or scaffold.

13. The apparatus of claim 11 whereby in use two levelling apparatus are attached to respective ground engaging ends of two parallel uprights of said support structure.

14. The apparatus of claim 11 whereby in use one levelling apparatus is attached to a ground engaging end of a parallel upright of said support structure.

15. A support structure comprising:
one or more cross-members; and
at least one levelling apparatus wherein said levelling apparatus comprises an attachment means attaching the levelling apparatus to the support structure, the attachment means including attachment member(s) which in use, extend at least partially through at least one of said one or more cross-members.

16. The support structure of claim 15 wherein said support structure is a ladder.

17. The ladder of claim 16 comprising one levelling apparatus.

18. The ladder of claim 16 comprising two levelling apparatus.

19. The support structure of claim 15 wherein the or each attachment member extend completely through at least one cross-member.

20. A levelling apparatus for a support structure having one or

more cross-members substantially as herein described with reference to the accompanying drawings.

21. A support structure comprising one or more cross-members and at least one levelling apparatus as herein described with reference to the accompanying drawings.

22. A ladder comprising at least one levelling apparatus as herein described with reference to the accompanying drawings.

AMENDED CLAIMS

[received by the International Bureau on 24 May 2002 (24.05.02)]

Claims 1,2,3,6,7,8 and 9 amended; claims 10 to 22 deleted; remaining claims unchanged.

1. A levelling apparatus for a ladder having a pair of side uprights and at least two hollow rungs, said apparatus comprising:

(i) a continuous tubular housing attachable to and spaced from said ladder, said tubular housing having a hollow interior of a length at least as long as a distance separating two adjacent ladder rungs;

(ii) an inner member telescopically movable within the hollow interior of said housing and securable at a desired position relative to said housing, whereby in use, said inner member telescopically moves parallel in relation to the side uprights of said ladder; and

(iii) an attachment means including at least one attachment member for attaching the housing to the ladder, wherein said attachment member(s) are releaseably engaged to said housing and said attachment member(s) extends at least partially through at least one adjacent hollow rung of said ladder.

2. The apparatus of claim 1 wherein the attachment member(s) extend completely through an associated ladder rung.

3. The apparatus of claim 1 wherein the attachment member(s) comprises a rod.

4. The apparatus of claim 1 wherein there are provided two attachment members.

5. The apparatus of claim 1 wherein there is provided one attachment member.

6. The apparatus of claim 1 wherein the attachment means further comprises at least one attachment member that extends only partially within an adjacent hollow rung.

7. The apparatus of claim 1 whereby said inner member is secured to said housing by securing means in a form of a securing pin insertable in a mating aperture of the inner member.

8. A ladder assembly comprising:
- (a) a ladder having a pair of side uprights and at least two hollow rungs; and
 - (b) a levelling apparatus comprising:
 - (I) a continuous tubular housing attachable to and spaced from said ladder, said tubular housing having a hollow interior of a length at least as long as a distance separating two adjacent ladder rungs;
 - (II) an inner member telescopically movable within the hollow interior of said housing and securable at a desired position relative to said housing, whereby in use, said inner member telescopically moves parallel in relation to the side uprights of said ladder; and
 - (III) an attachment means including at least one attachment member for attaching the housing to the ladder, wherein said attachment member(s) are releaseably engaged to said housing and said attachment member(s) extends at least partially through at least one adjacent hollow rung of said ladder.
9. The ladder assembly as claimed in claim 8, wherein there is provided a pair of said levelling apparatus wherein each of said levelling apparatus has attachment member(s) extending at least partially through an adjacent hollow rung of the ladder.

STATEMENT UNDER ARTICLE 19(1)

Amended claim 1 is novel in light of the citations of the International Search Report (ISR). None of the prior art teaches all of the following features of a leveling apparatus defined by amended claim 1.

1. A levelling apparatus for a ladder having a pair of side uprights and at least two hollow rungs, said apparatus comprising:

(i) a continuous tubular housing attachable to and spaced from said ladder, said tubular housing having a hollow interior of a length at least as long as a distance separating two adjacent ladder rungs;

(ii) an inner member telescopically movable within the hollow interior of said housing and securable at a desired position relative to said housing, whereby in use, said inner member telescopically moves parallel in relation to the side uprights of said ladder; and

(iii) an attachment means including at least one attachment member for attaching the housing to the ladder, wherein said attachment member(s) are releaseably engaged to said housing and said attachment member(s) extends at least partially through at least one adjacent hollow rung of said ladder.

US Patent Nos. 5,542,497; 5,232,067 and 5,551,529 and patents GB 2,300,445; GB 2,316,704 and GB 2,124,691 cited in the ISR all lack item (i) above which forms a working interrelationship with items (ii) and (iii). It will be appreciated that the tubular housing of the present invention provides strength and stability to the leveling apparatus when compared with the citations.

US Patent No. 5,542,497 describes a complicated ladder leveling attachment having a pair of inter-sliding channels one of which forms an extendable leg. The extendable leg requires one or more safety straps which is not required in the present invention. There is also no disclosure of an inner member telescopically moveable in housing (i).

US Patent No. 5,232,067 refers only to a slidable rail in abutment with an adjacent ladder side upright, not a tubular housing. Thus, it is also not spaced from the upright as required by amended claim 1. Similar comments apply to GB 2,300,445 and GB 2,316,704.

A ladder stabilizer described by US Patent No. 5,551,529 does not include a tubular housing and instead comprises a pair of brackets in abutment with the adjacent side upright of the ladder and is not spaced therefrom. There is no disclosure of an inner member telescopically movable within a housing and parallel to an adjacent upright of the ladder. Instead extendible legs project outwardly from an adjacent ladder uprights.

A ladder leveling leg describe by GB 2,124,691 lacks housing (i) and inner member (ii). Instead, a treaded extendable leg is attached to a ladder by a clamp.

Patent application CA 2,281,309 for a ladder stabilizer does not teach items (ii) and (iii). In particular, an inner telescopically extending member does not extend parallel to side rails of a ladder and the apparatus does not comprise an attachment member that is releaseably engaged with the housing. Instead, the attachment member is an integral part of the housing.

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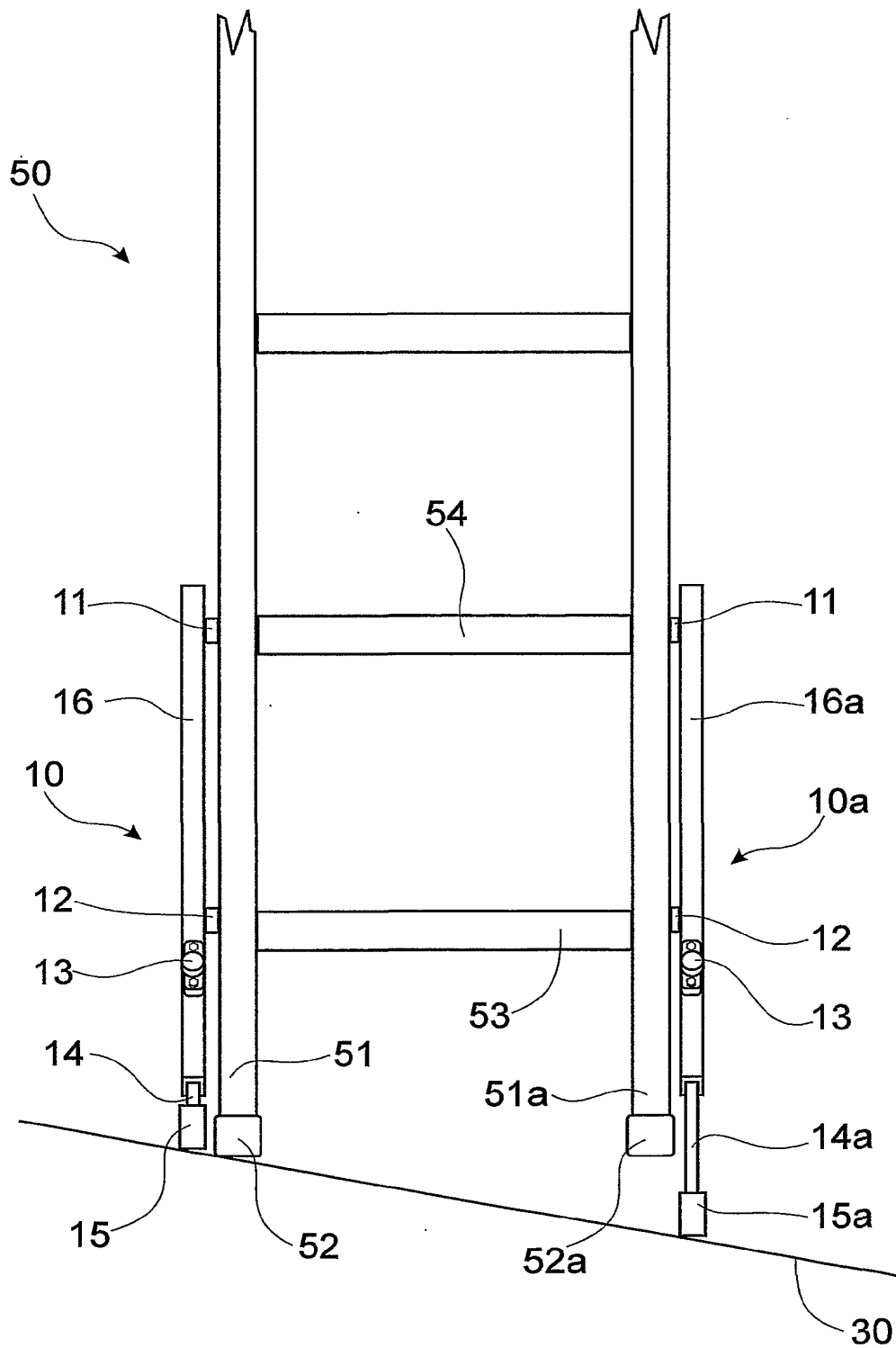


FIG. 1

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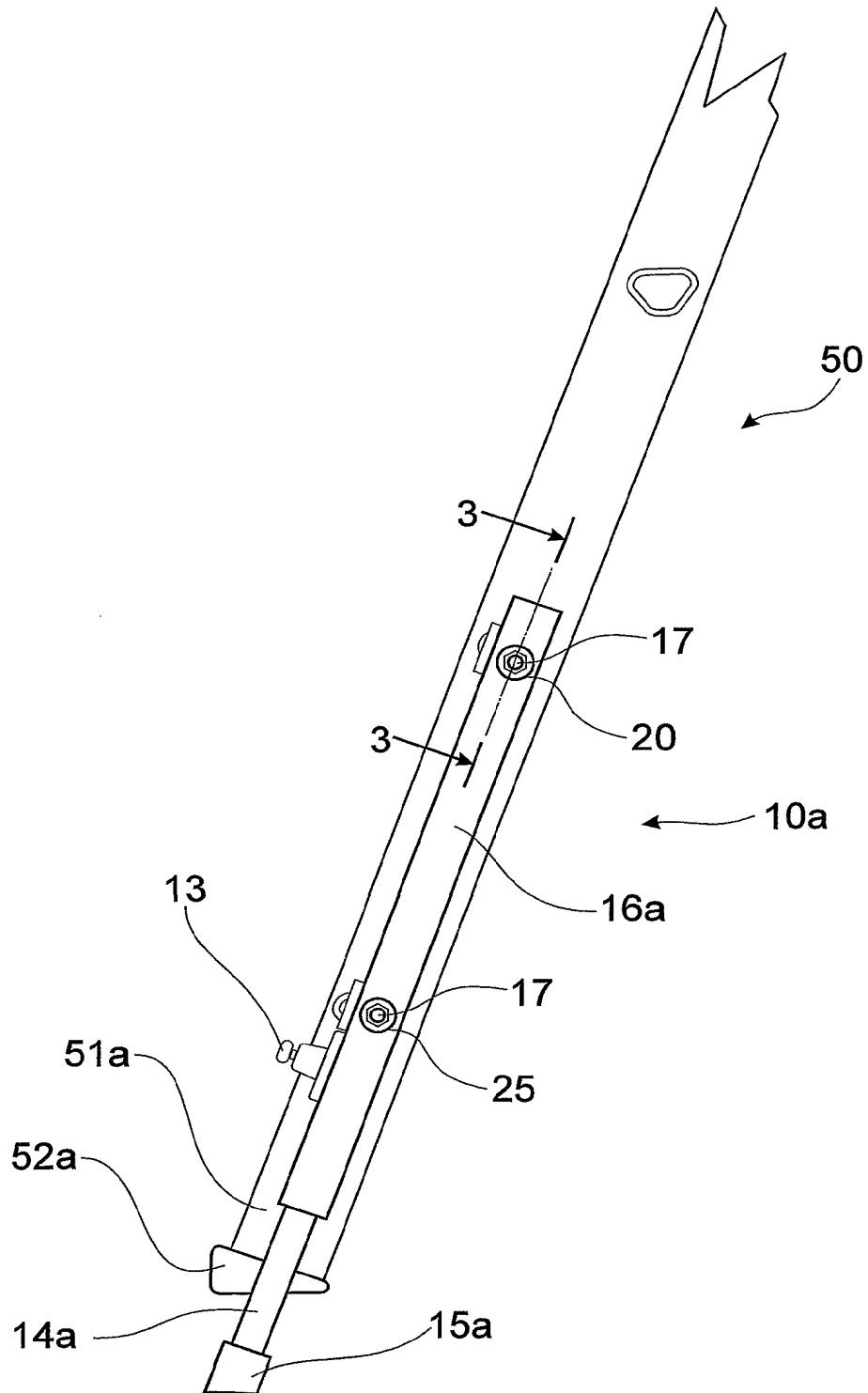


FIG. 2

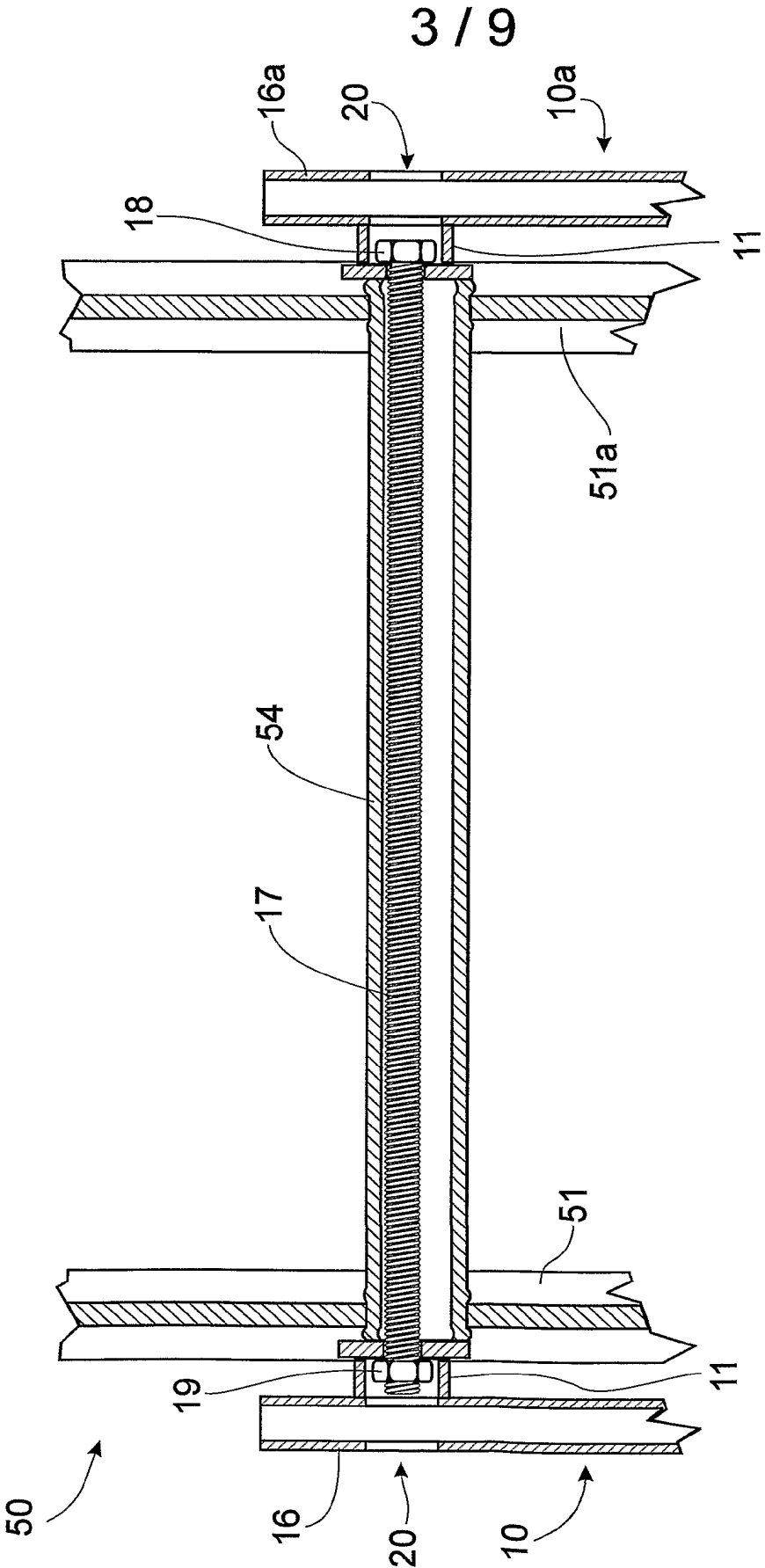


FIG. 3

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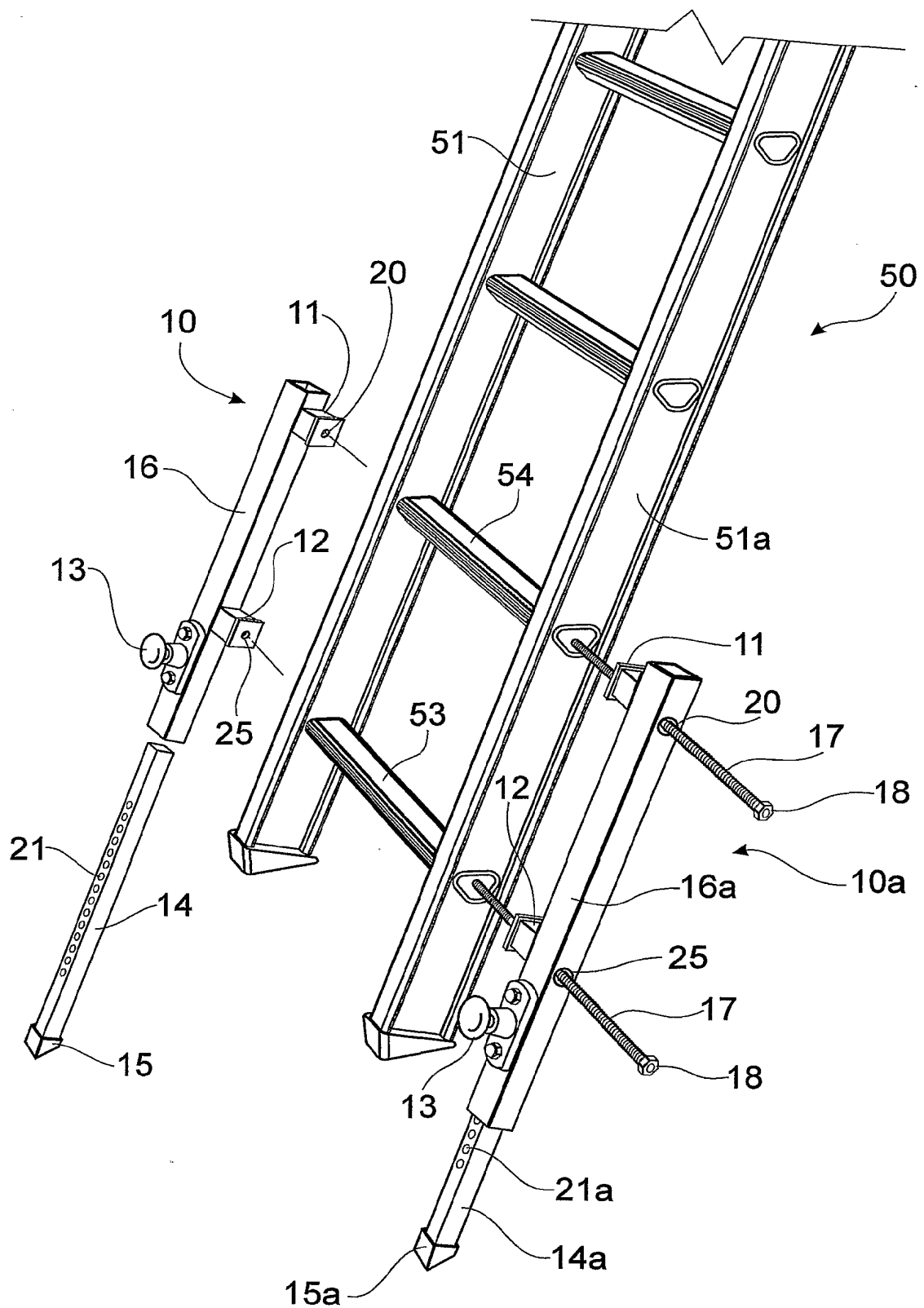


FIG. 4

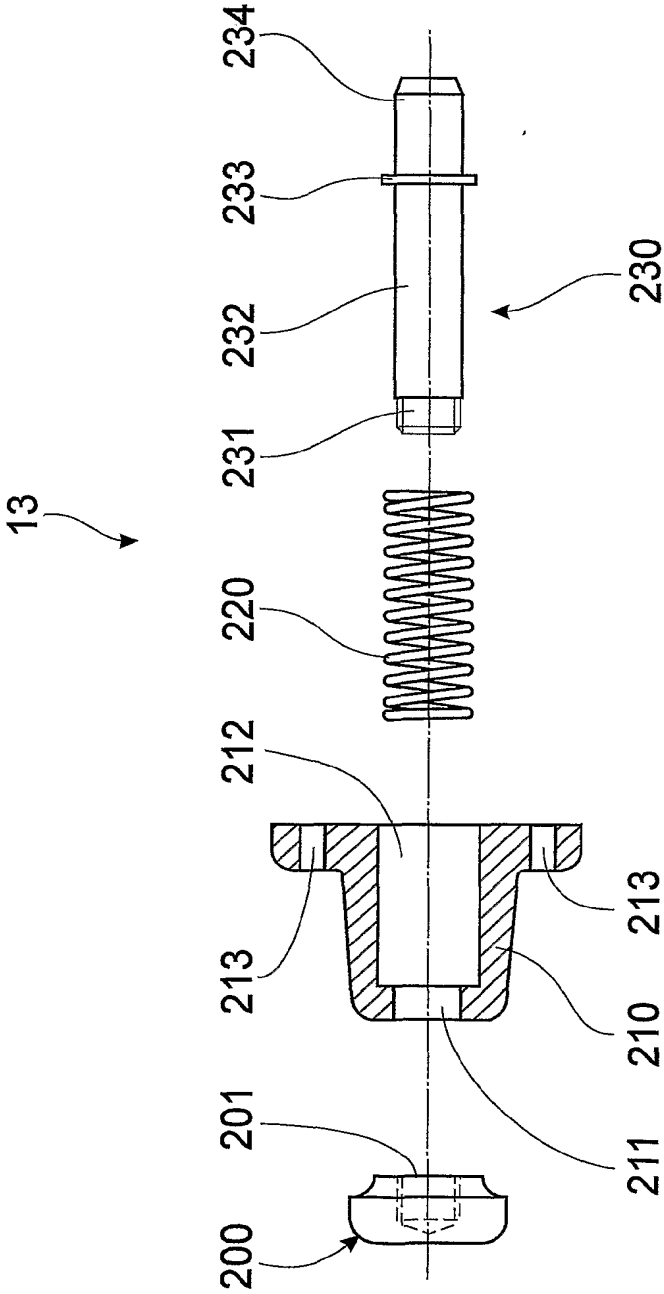


FIG. 5

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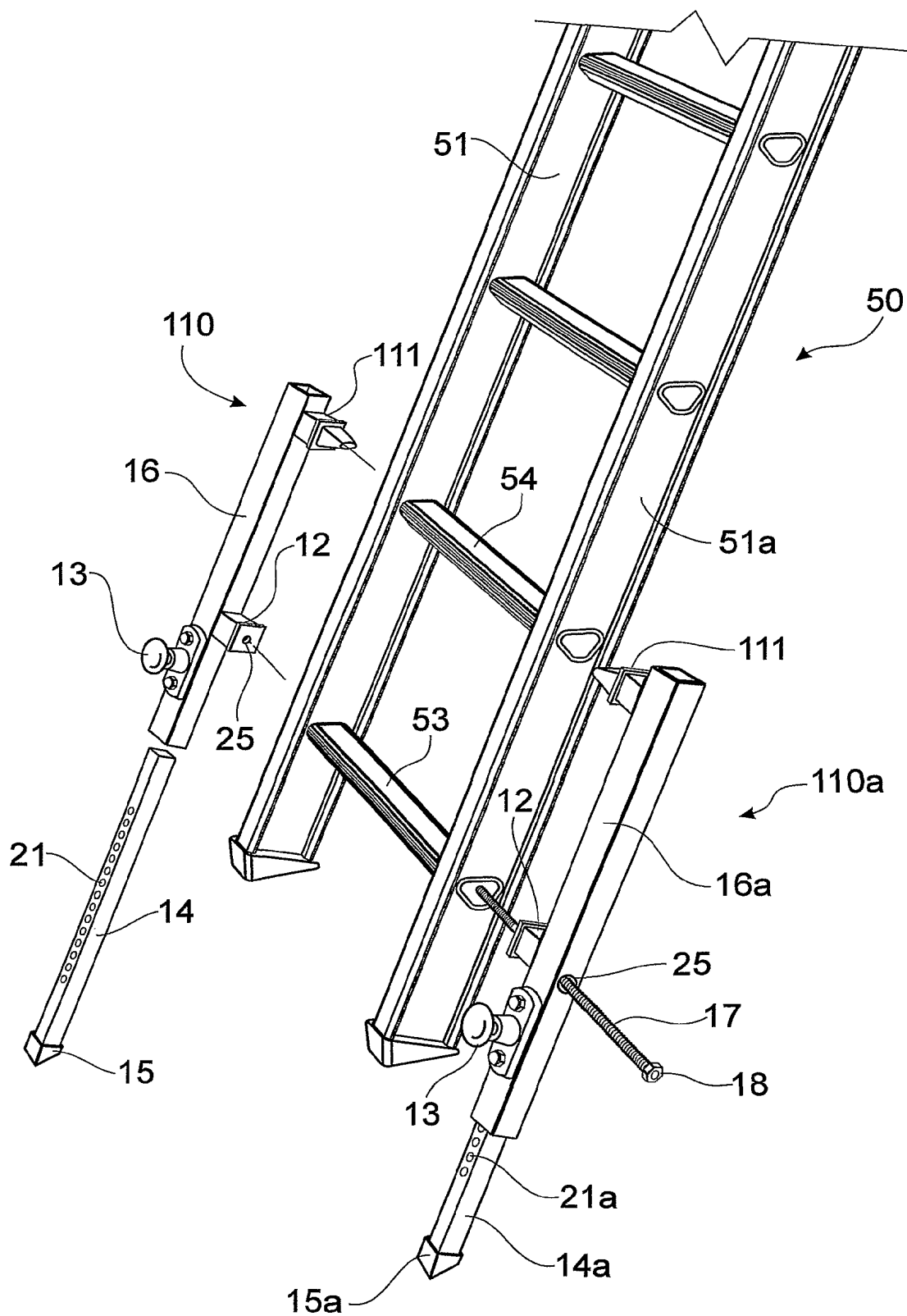


FIG. 6

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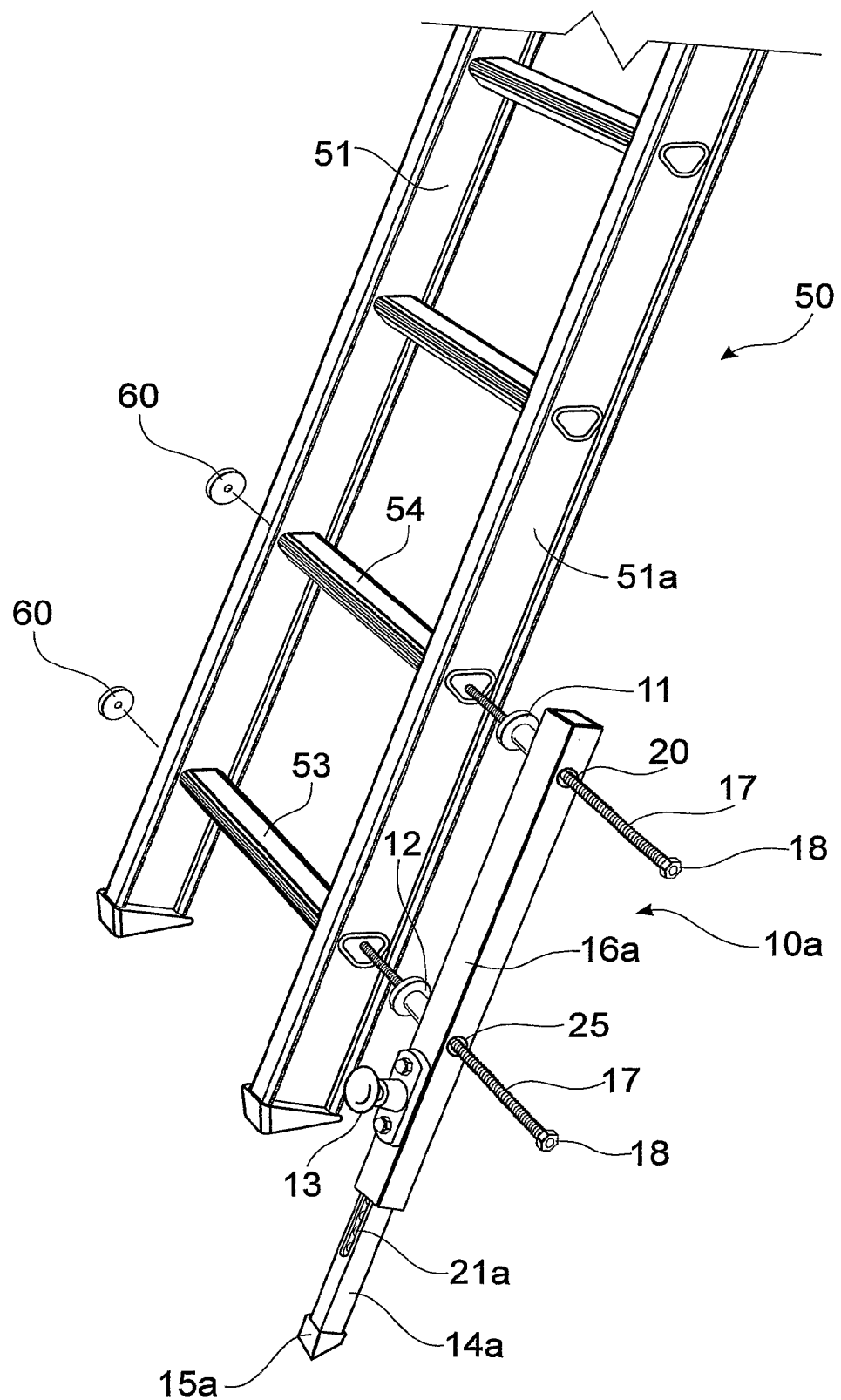


FIG. 7

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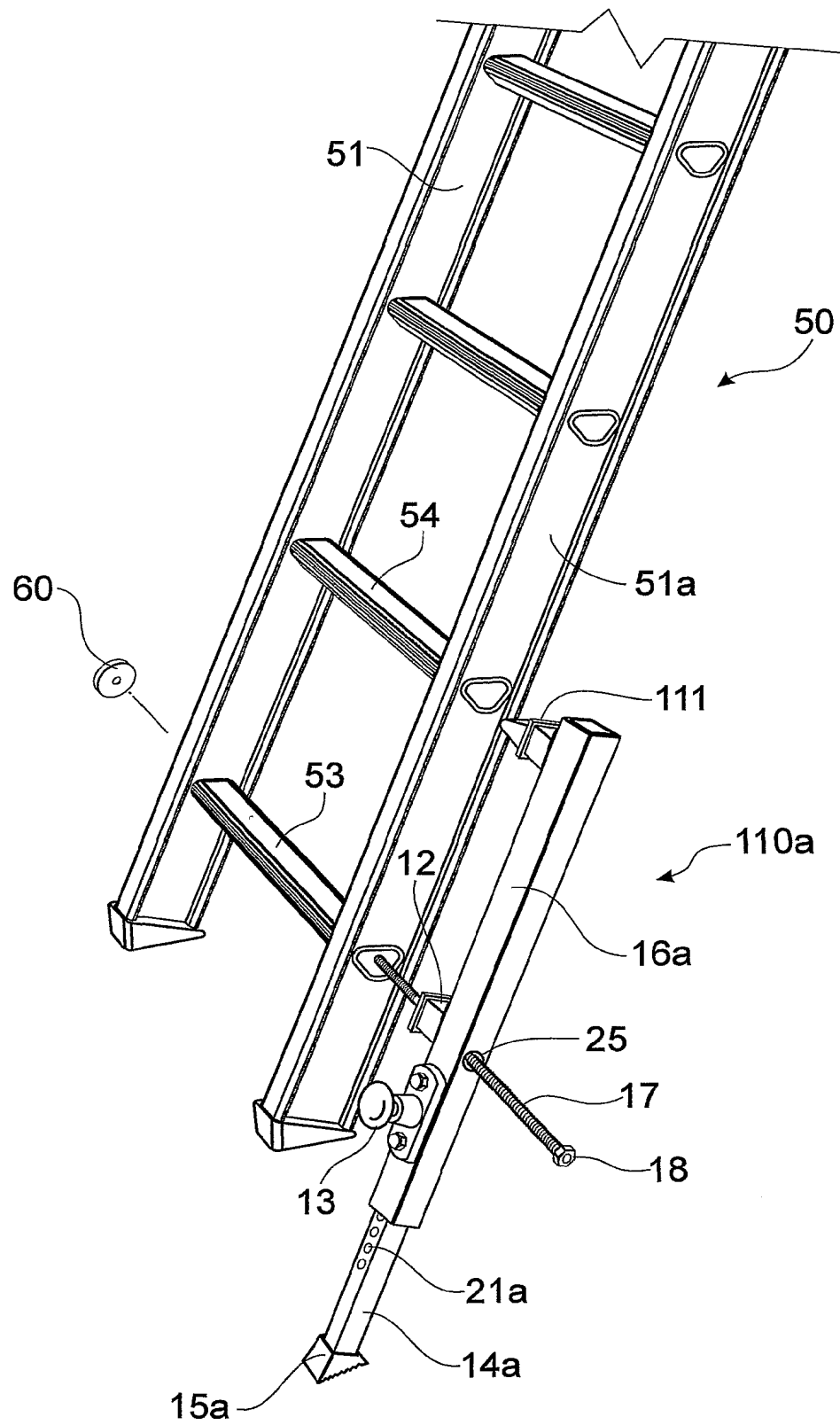


FIG. 8

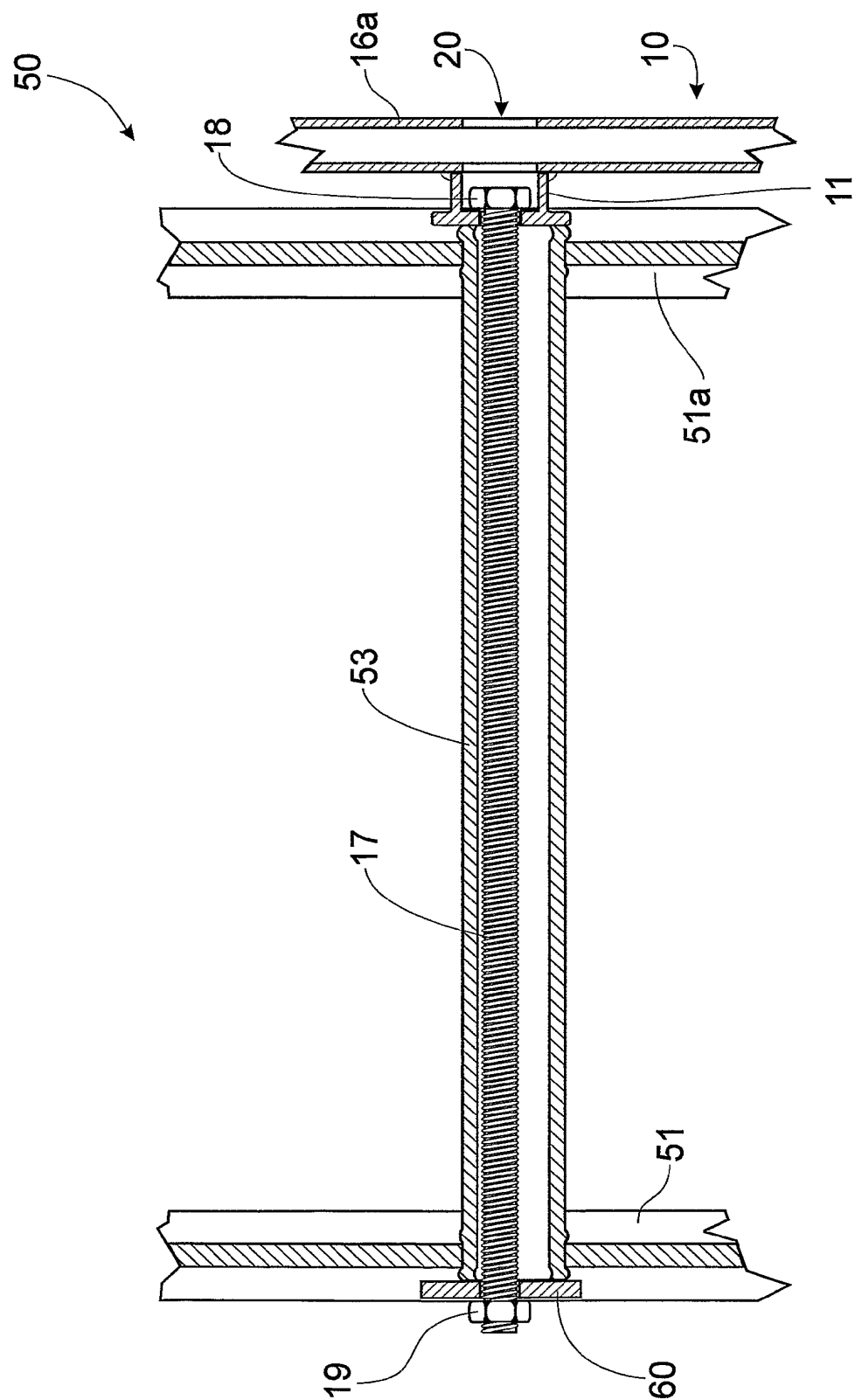


FIG. 9

INTERNATIONAL SEARCH REPORT*

International application No.

PCT/AU02/00080

A. CLASSIFICATION OF SUBJECT MATTERInt. Cl. ⁷: E06C 7/44, E04G 5/02, F16M 11/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DWPI ladder etc and level etc and rung etc

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2316704 A (THOMPSON) 4 March 1998 figs	1-22
X	GB 2300445 A (ORHAN) 6 November 1996 figs	1-22
X	US 5551529 A (MOLITOR) 3 September 1996 fig 6	1-22

☒ Further documents are listed in the continuation of Box C
 ☒ See patent family annex

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

14 February 2002

Date of mailing of the international search report

18 FEB 2002

Name and mailing address of the ISA/AU

 AUSTRALIAN PATENT OFFICE
 PO BOX 200, WODEN ACT 2606, AUSTRALIA
 E-mail address: pct@ipaaustralia.gov.au
 Facsimile No. (02) 6285 3929

Authorized officer

P. WARD

Telephone No : (02) 6283 2129

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU02/00080

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5542497 A (MACYSZYN) 6 August 1996 fig 5	1-22
X	US 5232067 A (GRIFFITH) 3 August 1993 figs	1-22
X	GB 2124691 A (EADE) 22 February 1984 figs	1-22
X	CA 2281309 A (MCFERRAN) 29 February 2000 figs	1-22

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU02/00080

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member
GB	2316704	NONE
GB	2300445	NONE
US	5551529	NONE
US	5232067	NONE
GB	2124691	NONE
US	5542497	NONE